A Teacher Learns

An Honors Thesis (HONRS 499)

by

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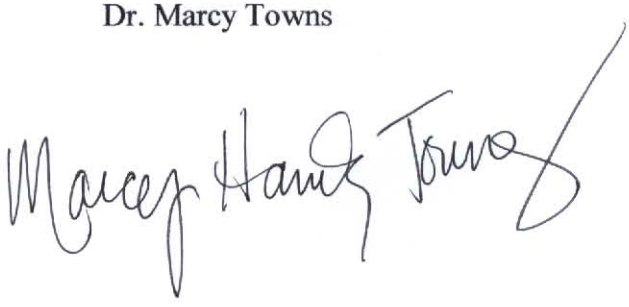

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Abstract

This project contains a pre-service teacher's perspective of her summer research project, working for a weeklong conference for in-service high school chemistry teachers. The work contains a narrative account of the workshop, including reflection on what she has learned. The work also includes a summary of her research on laboratory in the classroom. Workshop evaluations from the in-service Chemistry teachers were also analyzed. From this data, suggestions for future in-service high school chemistry teacher workshops are formulated. One final reflection is made applying her knowledge from the workshop to her student teaching experience.

Acknowledgements

-- I would like to thank Dr. Towns for all her help throughout this project. The opportunities that I have been given because of her belief in me are truly amazing.

-- All my sincerest gratitude goes to Dr. Robert Morris, because without him, I would never have done summer research with Dr. Towns.

-- Without my family and friends, I would not have had the drive to complete this project. Many thanks to all of you!

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The Opportunity of a Lifetime

I was staying on campus for the summer and I wanted to do something besides just go to class. I decided that I would apply to do summer research with the Chemistry Department. I went in with the hope that I would receive an opportunity to work with one of the professors on some of his or her research. Although I had not had the laboratory experience many of my peers had, I did not take the same courses they had because I was a secondary education major.

Several weeks later, I received notification that I would indeed be working that summer with Dr. Marcy Towns. When I met with Dr. Towns, I learned that I was not going to be doing the same type of research that my friends were doing. I was doing something much better; I was going to help Dr. Towns run a workshop for teachers! It was a weeklong Flinn Scientific Foundation Summer Workshop intended to provide in-service chemistry teachers with new ideas and practices. I would help Dr. Towns prepare the department and campus for our guests before the conference. During the week of June 24, I was to be an aid for the presenters and the other teachers, while I got the opportunity to sit in on activities and lessons and learn. Following the workshop I would complete research and present what I had learned from the workshop to the chemistry department.

Before the summer started I was elated at the opportunity that I was given by the department to not only complete research, but to do so in a manner that would directly influence my future career as a secondary chemistry teacher. I would have the chance to learn from current teachers that know what works for students and how to make the most of their education. I knew that I was going to gain experiences that most first year teachers could only dream of. I also was aware of the work that I needed to put into this opportunity, but the reality was far more exhausting than I would have guessed.

Effort will make the most of an Opportunity

Two weeks before the Flinn Workshop was going to begin, Dr. Towns and I started getting things together and ready to have a successful workshop. The majority of our time was spent doing paperwork and getting things organized. However, I was also given several articles to read that would help me to have some equal footing with the workshop participants. Dr. Towns predicted that these articles on concept learning and student misconceptions would allow me to understand the material that would be covered in the presentations during the conference. I read Susan C. Nurrenben's article, "Concept Learning versus Problem Solving: Is There a Difference(7)?" From her article and several follow up articles by other authors, I was able to know very concretely what is meant when a teacher speaks about concept learning (7, 8, 9). When a student learns a concept he or she can use that knowledge to answer mathematically based problems (algorithmic problems), or problems that do not have to do with calculations (more conceptually based problems). These conceptual questions tend to be more abstract than the algorithmic questions that are many times asked of students. The far larger problem lies in that students are taught to solve algorithmic problems far more often than conceptual problems. Thus, students do not understand the concepts behind the problems that they solve; they only know the process or algorithm to solve the numeric questions. Data also showed that for students to be successful at both types of questions they must be taught both. Students to not readily pick up either type of learning through the other. Dr. Towns and I discussed this reading at length. I concluded that although problem solving is generally the focus of high school education that I would not allow for concept learning to go overlooked in my future classrooms. In preparation for the conference, I also read an article on student misconceptions by Mary Nakhieh (6). Her article draws out some of the most common misconception that students have

about the nature of chemistry. This article proved to be very helpful to me so I know how not to lead my future students into misunderstandings about chemistry. After several weeks of preparation, I was ready and excited about the workshop.

The teachers arrived late Sunday evening and early Monday morning, from this point on there was nothing but excitement and work to be done. In between and after my summer classes, I spent time preparing laboratories, running errands, and most importantly learning things that I could not in general methods classes. Each day was divided into sections both in the laboratory and in the classroom. The classroom sessions were to provide times for discussion and demonstrations that could be used for high school students. During these sessions not only were the teachers hearing and seeing the presenters' information, but they also received time to share their own ideas and thoughts. The laboratory sessions consisted of student labs that the teachers had the opportunity to perform just as their students would have done.

One of the classroom sessions that particularly interested me was on how to successfully motivate students to read their chemistry texts. I knew that I would want my students to understand the content; not only by classroom activities, but to also read their texts. I was unsure how I would ensure that my students were reading their material. Some of the ideas the experienced teachers had included not allowing students to bring their books to class but bringing their notes from the book instead and taking the time to teach students how to correctly read a text book, specifically a science one. The second idea had been especially successful for struggling students. Both of these ideas were used by many of the teachers participating in the conference, and all of them said that it worked. This was another set of suggestions that I will always keep in mind for my future classes and hope to incorporate them. I feel that if students

learn how to read content material, then that will form the foundation to obtain more information and allow the beginnings of problem solving skills.

Much of the classroom time during the workshop was spent discussing making laboratory a valuable learning experience for the students. We talked about how to choose good activities for the students. The labs that would be the most valuable to students are the labs that illustrate unknown concepts. Essentially, the laboratories that make the abstract concrete are the ones that are the most beneficial to the students. The young men and women need to be shown how something in the laboratory relates directly to the theory that is being discussed in the classroom and occurring in the natural world everyday. A good teacher cannot assume that a high school student has the prior knowledge to connect the theory to the activity; the students must be trained to begin to see these differences.

The students will learn how to make these connections on their own when they become actively involved in their laboratories. This is the biggest challenge for a teacher using lab activities. It is not to select a good lab, but to develop it so that the students are actually addressing the intended purpose. This requires that the students become actively involved and invested in the laboratory experiment. Some of the suggestions from the literature included having students write out their own procedures that would be taken into lab and used to guide them through the activity. This would ensure that all students had read the procedure and taken enough time to write down what they would need to know. Another idea that had been successfully used by teachers in the past was having the young adults create data tables of their own. This would require the pupils to selectively decide what information was important to the completion of the laboratory. Students would need to be taught both of these laboratory procedures at the beginning of each year. However, it would enable the students to take more

ownership of the activities they would perform, instead of simply following their instructors' directions. Another suggestion that was proposed and discussed during the course of the workshop was having students complete laboratories where they would write different procedures to determine what an "unknown" substance was. The purpose of this type of activity would be to have students connect the information that was learned from prior labs and classroom activities and apply all of that into creating a lab on their own that would allow the students to determine the identity of a particular material. All of these ideas for the laboratory were outstanding, and I felt that when I had a classroom of my own that I would incorporate some or all of them into my lab activities.

There are occasions when students cannot go to the laboratory. This occurs primarily for reasons of safety, cost, and time. It is at these times that good science teachers take advantage of demonstrating things to students. Each day during the workshop more than an hour was devoted to presenting good demonstrations. The workshop presenters did not use the majority of this time but the participants of the workshop did. These were some of the best portions of the workshop. Not all of the ideas were actual demonstrations, but low cost class activities. All of these activities and demonstrations that I was learning came from teachers that are just like I will be in a few years. I was also given the opportunity to perform a demonstration for the other teachers. I considered this to be quite an honor that these experienced teachers considered me enough of a peer to demonstrate an activity for them. I created an apparatus that would allow methane gas to flow through ethanol and become saturated with the alcohol so when it reached the Bunsen burner the flame was green. I was treated like an expert during this activity and was so well treated by my peers that I knew that I wanted to work with people like these for the rest of my life.

The laboratory portion of the workshop was very fun as well as educational. The presenters set up many labs for the participants to actually go through and perform. The labs that were chosen were activities that the presenters found to work very well in their classrooms. The best part of this activity based portion of the conference was that the teachers could see if the labs would actually work for their purposes without having to set them up all on their own to learn that they would never be able to use them. It was also very nice to be able to see the products of these activities instead of just hearing how wonderful and successful they were. By completing laboratories the participants and myself were able to feel and see the moment something went right or something began to make sense and renew our love of learning as well as our desire to share these wonderful activities with our students. One of my personal favorites was a lab were silver nitrate was reacted with hydrochloric acid to precipitate the silver out of solution and that would coat the inside of a test tube. This lab would very visibly show students a replacement reaction taking place and showing them something that was very visually pleasing.

Friday June 28 after everyone had gone home was a bittersweet moment for me. I was going to get some needed rest, but I also new that I was seeing the end of one of the greatest learning experiences of my life. I was able to learn from the people who were still actively working to best educate today's students and listen to their successes and learn from their past mistakes. I now had the knowledge from the workshop, the rest was up to me to use and develop once I had a classroom of my own.

Time for Analysis and Research

In order for me to complete my summer research, I had to take a portion of what I had learned from the workshop and apply it to research of my own. Since we had spent so much time working on making the laboratory the most effective it could be for students, I planned on researching some aspect of lab in the classroom. The information that I found from several sources, including sources from both *The Science Teacher* and *The Journal of Chemical Education*. My research lead me to conclude that although students enjoy that they are not in a lecture environment, they are not necessarily learning all that the lab has to offer (1, 3, 4, 5, 10). Studies show that the most effective way to teach science is through lecture and laboratory, the laboratory needs to be drawn into the lecture environment as well (1, 2). The most effective type of laboratory that is used today in American high schools is inquiry-based laboratory (3, 5). In an inquiry-based lab, more of the activity and planning is placed on students instead of the teacher. These activities include active processes involved in scientific thinking, investigation, and the construction of knowledge. To create an inquiry based lab; a teacher would include many of the same techniques that we discussed during the Flinn workshop. One very good type of inquiry-based laboratory is the "unknown" lab that I discussed earlier. To make an activity inquiry based, it does not have to be a brand new lab, it takes changing the laboratory from a complete write up to allowing the students to create their own data tables or other portions of the lab. Student lead extensions of classroom or laboratory concepts also provide a wonderful basis for inquiry-based learning.

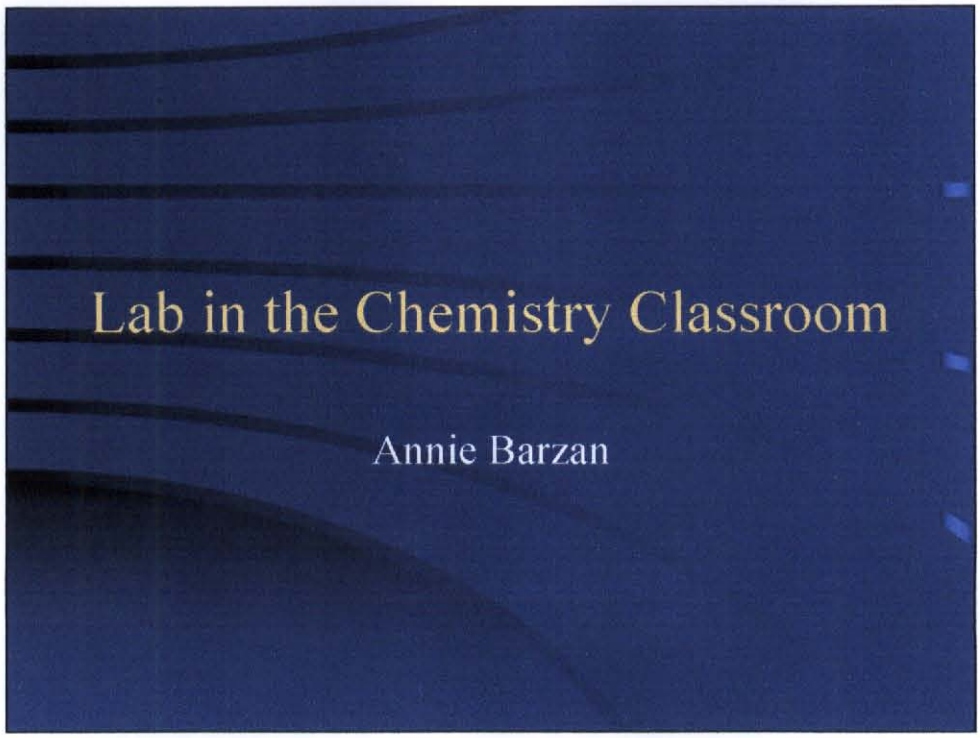
I also discussed the use of a discrepant event. A discrepant event is something that occurs in a laboratory or a demonstration that students would not expect. These are the types of

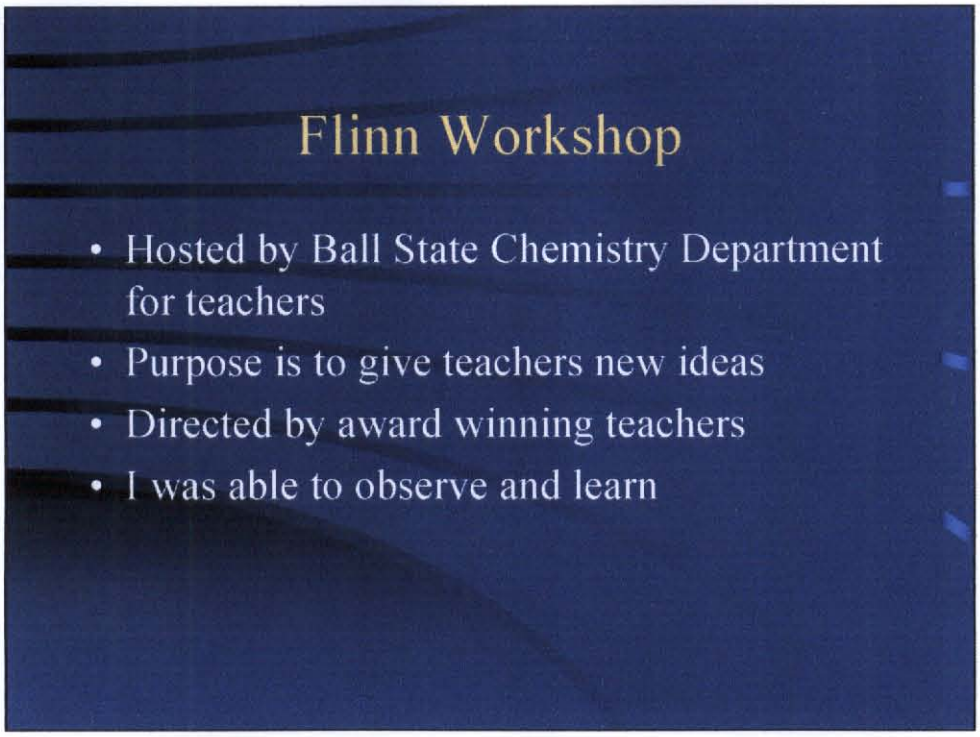
events that can spark student interest in a topic. Teachers can use these to draw students to propose ideas for possible inquiry based learning.

From all the information that I gathered both in experience and through research, I was to give a PowerPoint presentation to Ball State University's Chemistry Department. The presentations were used to provide undergraduate students with experience in presenting research as we all would throughout our future careers. As a teaching major, I had already spent a good deal of time in front of crowds of people, primarily my peers for many of my education classes. However, I had never presented anything quite like this before. I was giving chemists information about teaching. I was going to have to teach these chemists some of the terminology that would be the basis of my research. This was very good practice for me, because in my very near future, I would be presenting new information to classrooms full of high school students who had very little understanding of the concepts that I was going to show them. In just a few months, I would have to remember this experience when I was in front of students who did not know the language of chemistry, and I was going to be the one to introduce it to them and show them how to use it.

I thoroughly enjoyed giving my presentation to my professors and fellow chemistry students. The experience was memorable and I walked away feeling as if I had enlightened several people on how to best use laboratory in a classroom.

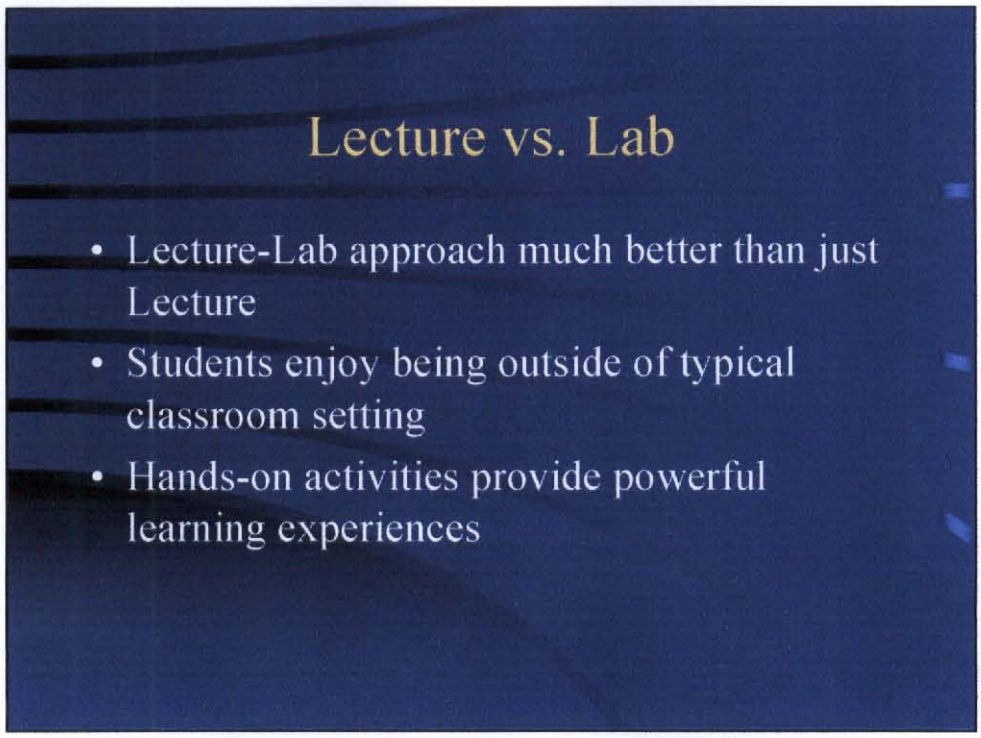
The next several pages will include my PowerPoint presentation as well as my notes.


Lab in the Chemistry Classroom
Annie Barzan



Three teachers from different parts of the country were winning both National & regional level awards by the ACS, NSTA.

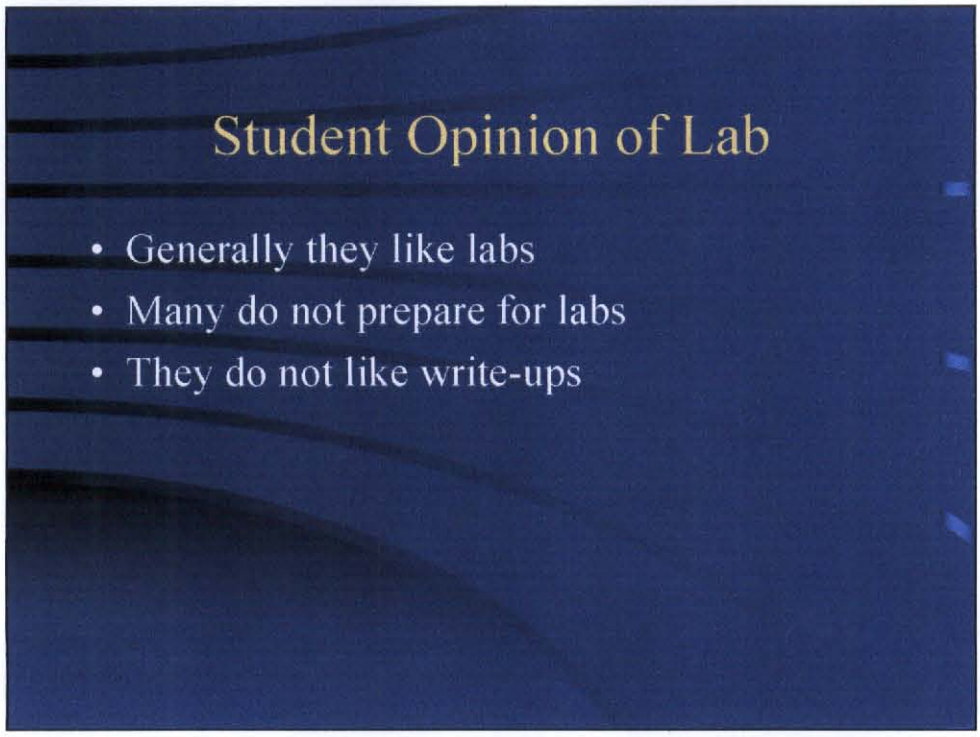
Through this experience, I was able to watch teachers and learn from their experiences. Many ideas that I picked up involved lab and demos in the classroom. An area that I feel is very important to science learning.



There are 2 ways to teach science, one with a lab, and one without. For example, Chemistry 100 does not have a lab with it.

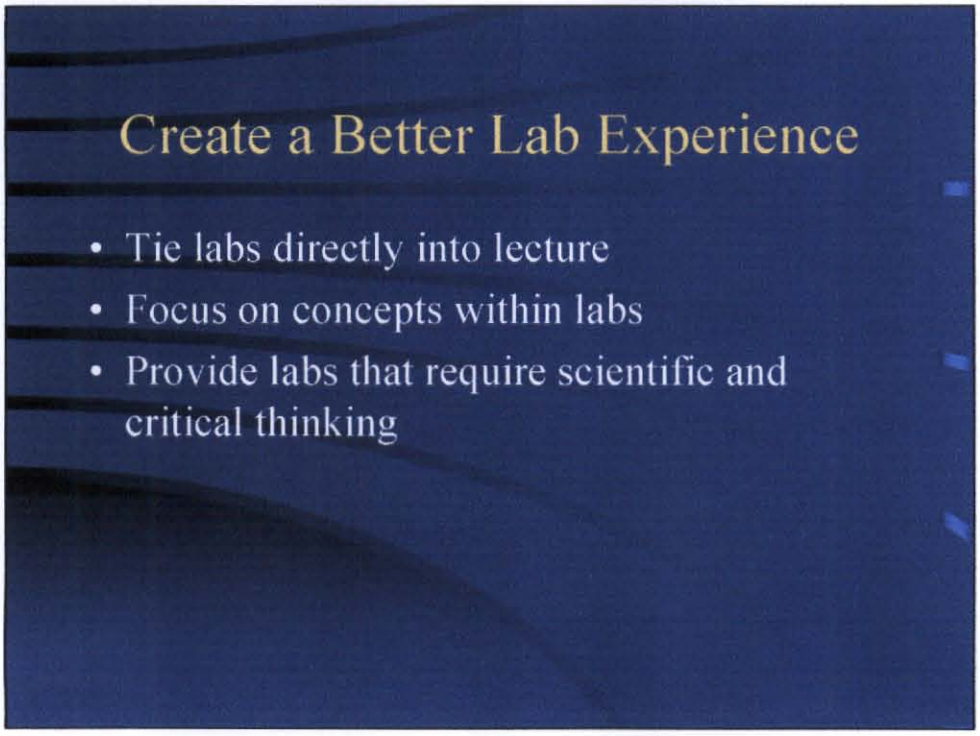
88% of first year chemistry high school students like lab.

52% of students without prior understanding of concept gain understanding through lab

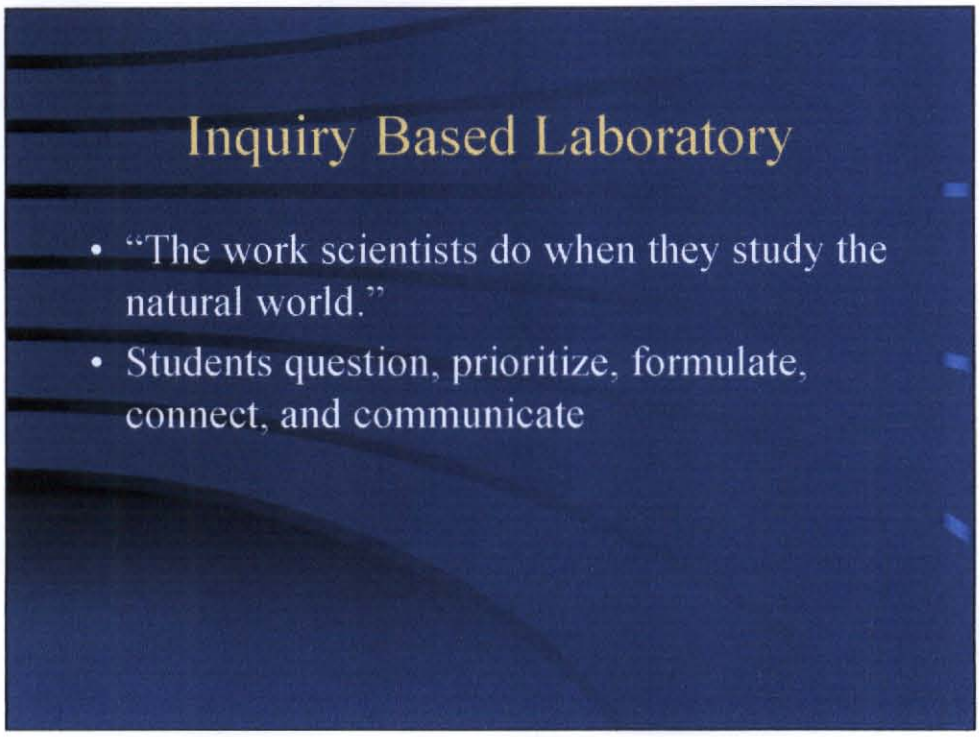


Only a few students partake in pre-lab discussions and understand procedure and concepts of experiment (*Journal of Chemical Education,* June 2002)

Students find laboratory write-ups to be tedious. They need outside subject support, such as English to support writing in science.



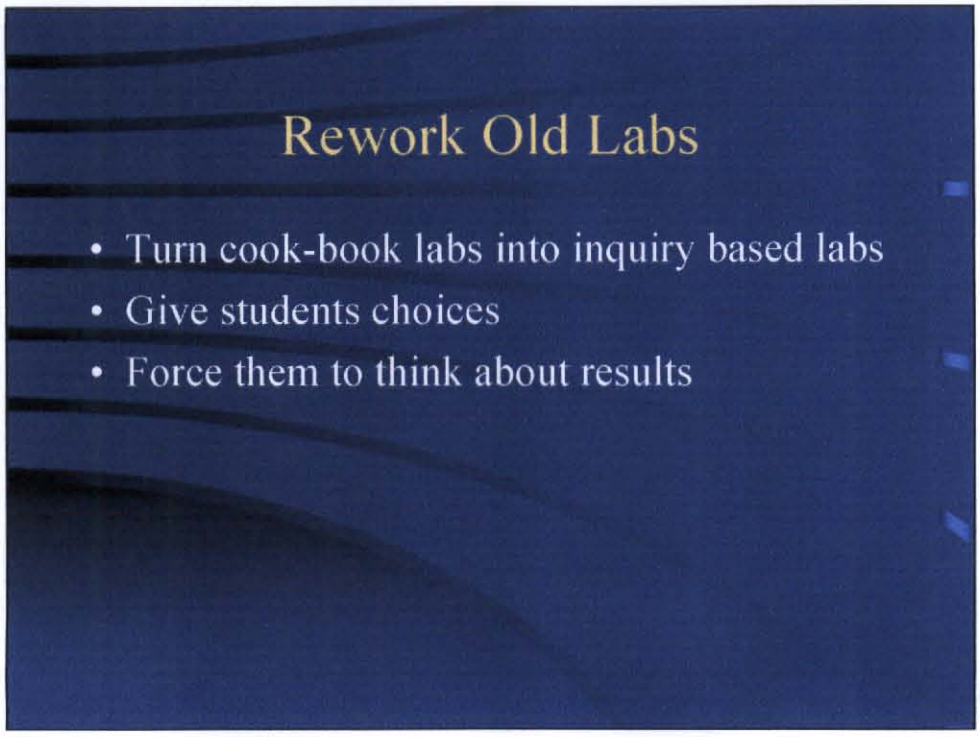
From what I heard and watched in the workshop, labs and demos need to have these elements to provide the students with the best experience.



Inquiry Based Learning – The active processes involved in scientific thinking, investigation, and the construction of knowledge.

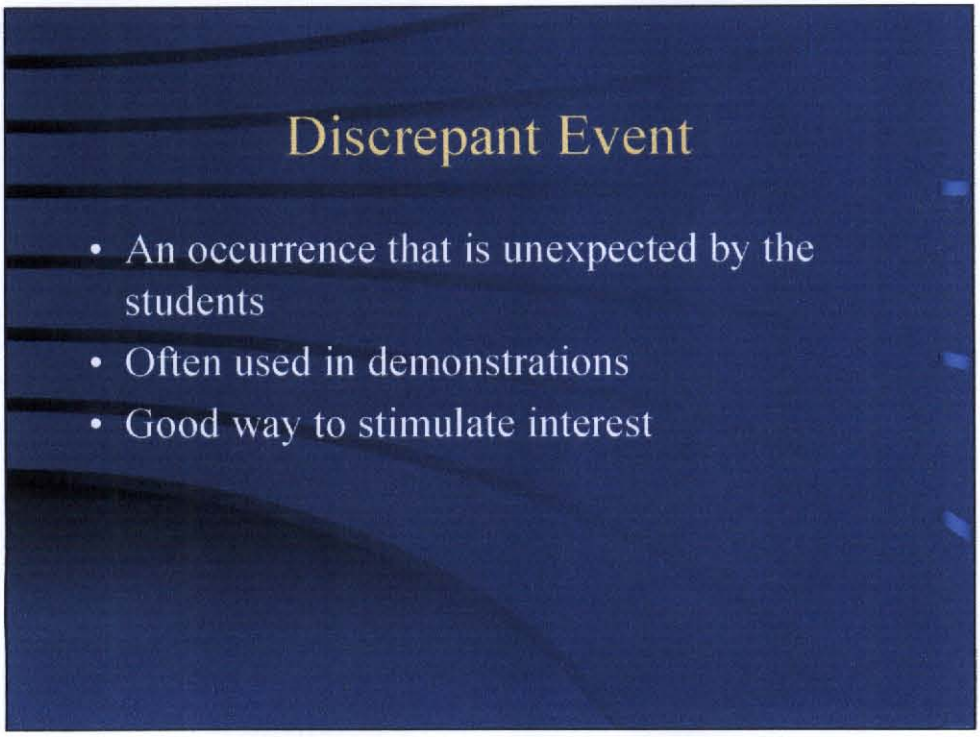
Students will be DOING, making choices, and decisions in the lab.

Example: unknown labs—students write own procedures



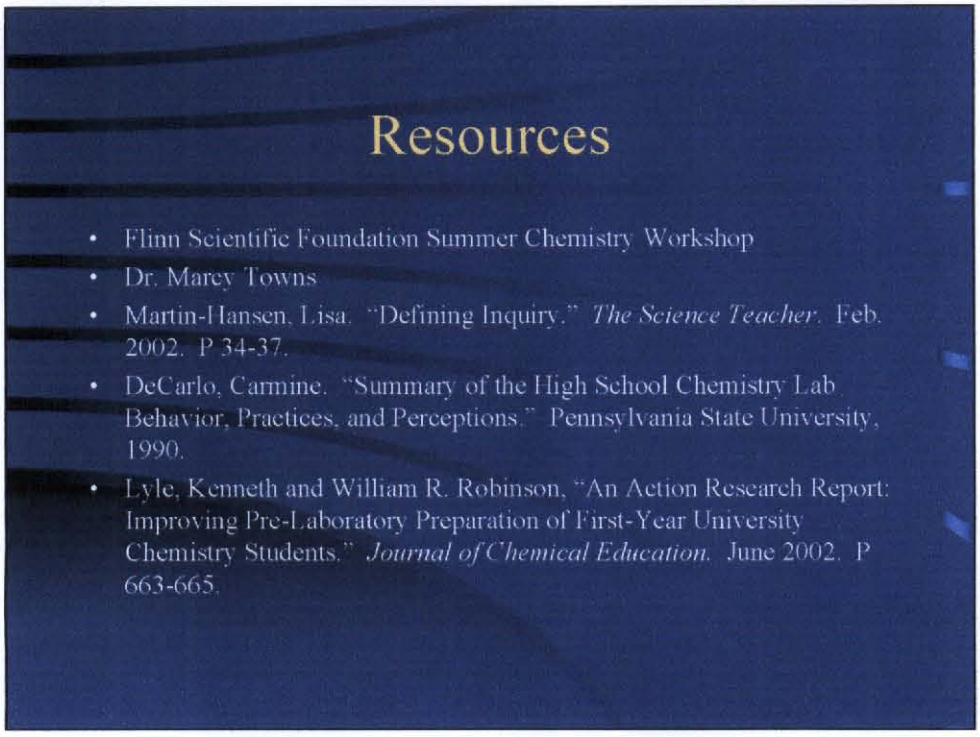
Cookbook lab is a lab where students do not understand the process, they only follow the procedure for the desired results

Have students write own data tables as part of pre lab. This will force them to think about what they are searching for and what is relevant.



Discrepant Event can provide a way to spark an inquiry session. The students could use this to be an example of something they want to discover by lab procedures. How did you make that happen?

Example: Thermite reaction



Thank the audience for their attention and say that you'd be pleased to answer any questions.

Teachers' Evaluations of the Flinn Workshop

On the last day of the workshop, just before the teachers went back to their homes to begin working on incorporating what they had learned, they were asked to fill out an evaluation for Dr. Towns and my purposes. Included in the evaluation was a portion to state what were the best and worst parts of the conference. The more interesting part of the evaluation was that the teachers were asked to share how they felt changed by the workshop. I found their thoughts to be very close to my own and very informative about the success of the workshop.

Overall, the teachers seemed to have thoroughly enjoyed the workshop and learned an incredible amount that they looked forward to using in the following school year. The portions of the workshop that they found the most beneficial included the opportunity to perform the lab activities that were presented, they could also choose which to complete and at what pace they wanted to move. The educators were very pleased with the chance to share ideas with their peers. Several of the teachers mentioned that it was very good for them to see labs and demonstrations that were low cost, low equipment, and using few chemicals because of their school budgets. Having new procedures for laboratories that had previously not worked successfully impressed others. Every one was also pleased with having paper copies of everything that was presented or discussed. Many teachers appreciated the helpful suggestions on making their laboratories safer for use.

Not everyone was always pleased. Some of the teachers felt that there were some things that could have been different. Several teachers mentioned that they did not like how much time was spent on material for advanced placement classes. Others did not want to be told classroom management styles or how to assess their students learning. These were more often experienced teachers who have had many years to develop these skills on their own. One other complaint

was that too many of the experiments or demonstrations were costly in equipment and chemicals. The only other request was for more time to be spent at the workshop during each day. Even with these negatives, each one of the teachers who completed the evaluation had far more praises than faults of the workshop.

Some of the more interesting and pleasing comments about the workshop included the attitudes that the teachers left on Friday having. Many of them left feeling as if their "batteries had been recharged" by the enthusiasm from their collogues. Teachers commented on newfound confidence in their abilities and their willingness to try new things. Several participants mentioned that they felt renewed in trying to make their students become more active and responsible for their class work. It was even said that the workshop reminded several how important activities were to student learning. All the participants left after five days of learning feeling refreshed and renewed about their careers.

A Student Teacher Reflects

I walked into my student teaching experience full of excitement and great plans. I fortunately still feel the same way. However, I do still feel as if I have something that most other student teachers do not have. I was given a binder full of good activities and a mind full of great ideas to begin my life as a teacher. Many of these ideas came directly from the Flinn Scientific Workshop. The question that comes to mind is have I used enough of this in my classroom?

My first week of student teaching, I had already brought many of the activities to school to use myself and also to share with my cooperating teachers as well as the rest of the science faculty. I had many new thoughts and activities to bring in and share with others. This helped me to get off to a great start.

Once I had settled in to my routine, grading and day to day planning began to take precedence over coming up with demonstrations for each day. There had been an enormous amount of demonstrations and activities that I wanted to use in the classroom, but as my time slipped away, so did the extra activities. However, I had already internalized some of the classroom techniques that were given to me by the workshop.

Overall, I do not feel that I have used my Flinn Workshop experience to the fullest throughout my student teaching experience. I realize now that in the future, I am going to force myself to make more time for these wonderful activities that assist student learning. I know that all is not lost, because I have many more years of teaching myself and I know that I will to continue sharing my ideas from the Flinn Workshop for years to come.

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